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17th CRC ON-ROAD VEHICLE EMISSIONS WORKSHOP
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Comparison of Remote Sensing Devices (RSD) with Gravimetric Measurements of Light-duty Gasoline PM Emissions

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RSD PM Sensitivity 2001

- Coordinating Research Council Study E-56
  - ***Diesel*** Emissions
  - Comparison of DRI and UD systems
  - Testing Conducted early 2001
- Neither system ready for quantitative PM measurements on-road
- Sensitivity was on order of 100's of mg/mi
- Poor correlation between systems for PM

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RSD PM Sensitivity 2005

- System improved
  - Better alignment of UV PM channel with IR gas phase channel
  - Better optics
  - Better detectors
  - Better data processing algorithms
- Sensitivity should be on the order of 10's of mg/mi.
- Primary function is first-order PM *Screening* (e.g. Yes/No) or *Classifier* (e.g. Low/Med/High).
- Quantification of actual emission level is important, but a secondary objective in this study.

Objectives

- Evaluate new RSD PM measurement methods under well controlled conditions.
- Identify the most promising driving modes for RSD measurements.
- Evaluate the performance of RSD systems for the real-world on-road measurements.

Remote Sensing Systems

- ESP: RSD 4000
  - Gaseous measurements
  - PM measurements: two channels
    - UV Transmissometer
    - IR Transmissometer
  - Commercial system

- DRI:
  - Gaseous measurements: ESP/RSD 3000
  - PM measurements:
    - UV backscatter light detection and ranging (LIDAR)
  - Research system

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RSD Parking Lot Testing: Test Layout

200'..150'..100'..75'..50'

25'

25'

50'..75'..100'..150'..200'

Mirror

Mirror

RSD4000

RSD3000

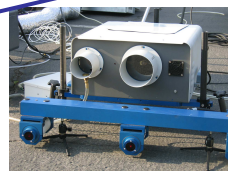
Video Camera

Lidar

Video Camera

Portable Battery

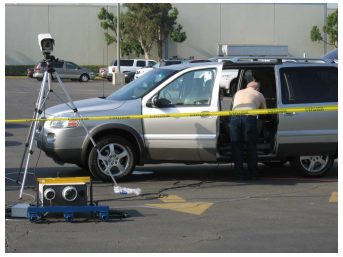
Rental Van



DRI Trailer

Rental Power Generator

A/C



ESP

DRI

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Vehicle Identification

#	MY	OEM	Model	Type	Disp (L)	Mileage	Smoke Type	Target PM (mg/mi)	UC PM Rate (mg/mi)
1	1997	Ford	Escort	PC	2.0	25,598	Normal emitter (no smoke)	< 5	1.51±1.12
2	1985	Toyota	Camry	PC	2.0	268,423	Light Black (invisible)	25 to 75	25.24 ± 12.06
3	1991	GMC	Sonoma	LDT	4.3	171,487	Light Blue (invisible)	25 to 75	6.86±2.97
4	1981	Toyota	Pickup	LDT	2.4	119, 728	Moderate Blue	50 to 500	863.16
5	1995	Dodge	Dakota	LDT	2.5	123,974	Moderate Black	50 to 500	216.07±100.30
6	1963	Studebaker	Avanti	PC	4.6	high	Heavy Blue	50 to 500	1718.21±1647.26
7	1998	Toyota	Camry	PC	3.0	82,704	Heavy Black	50 to 500	60.38±2.80
8	1986	Mitsubishi	Max	LDT	2.0	163,913	Gray	50 to 500	69.61±11.35

*PC = Passenger Car; LDT = Light-Duty Truck.

Note: Test fleet was chosen to evaluate the RSD PM measurement equipment over a full range of emissions. The fleet was not designed to be strictly representative of the on road vehicle fleet, other than to include as broad a range as possible.

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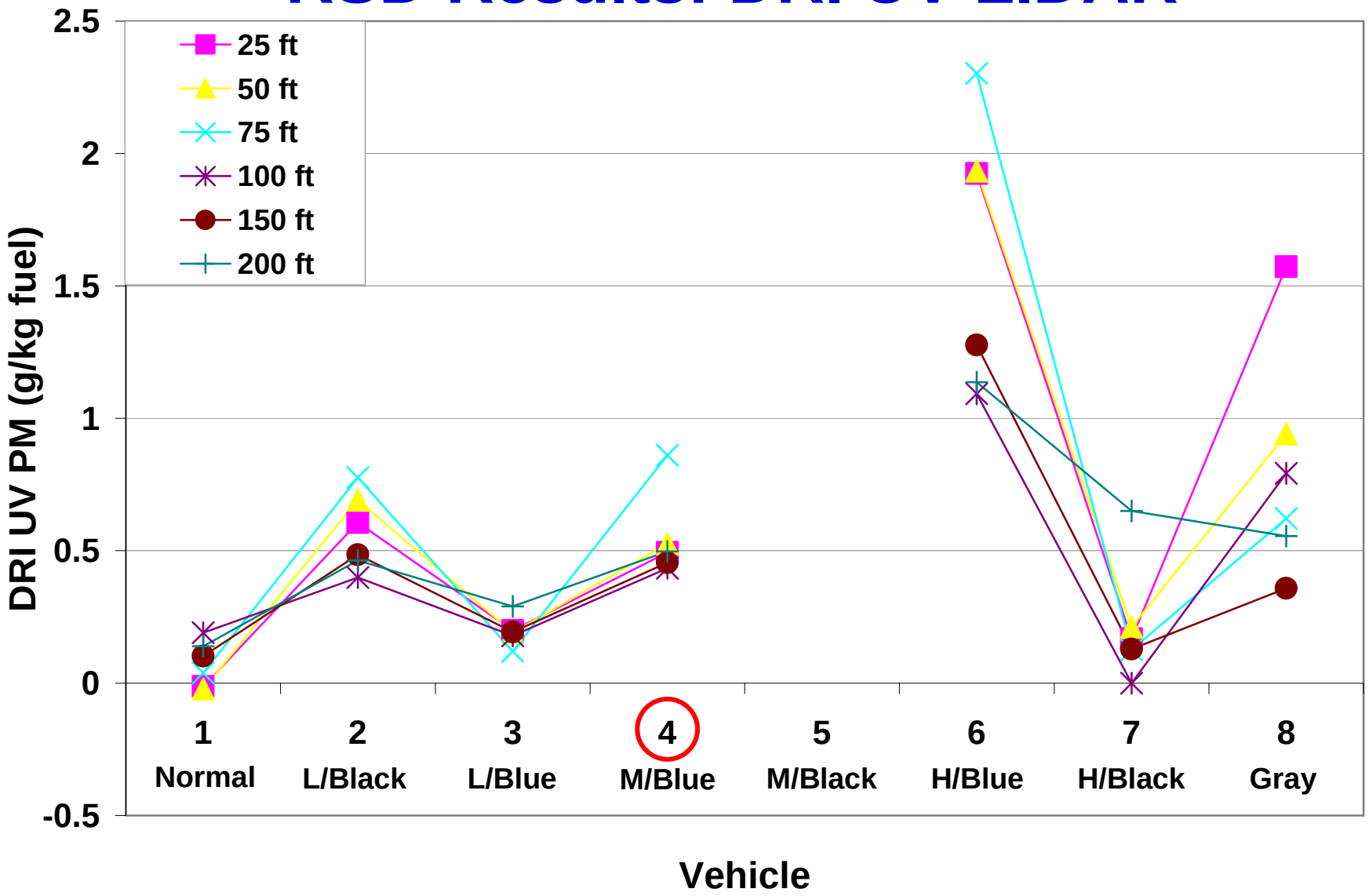
RSD Results: DRI UV LIDAR



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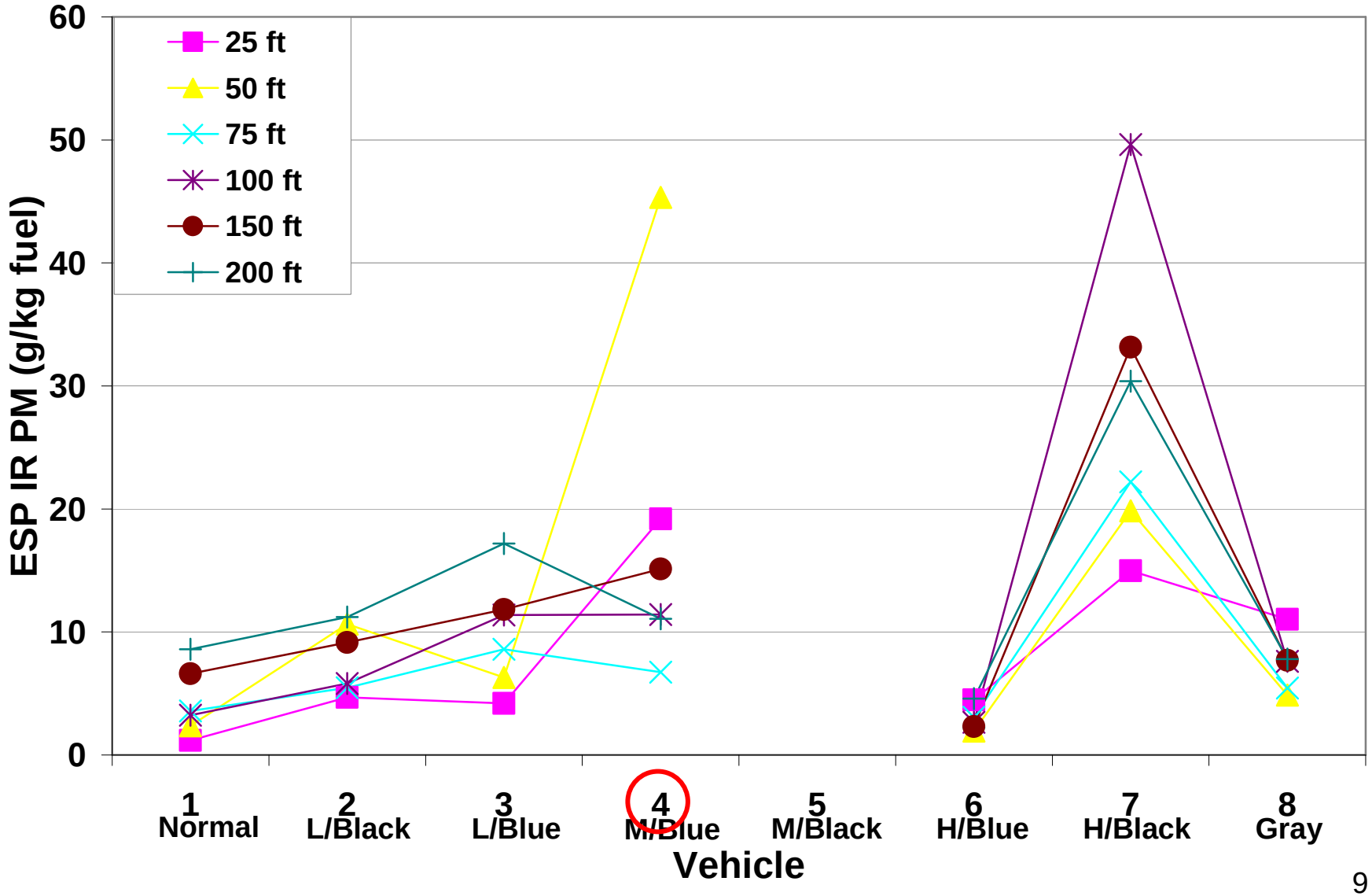
RSD Results: ESP IR Transmissometer



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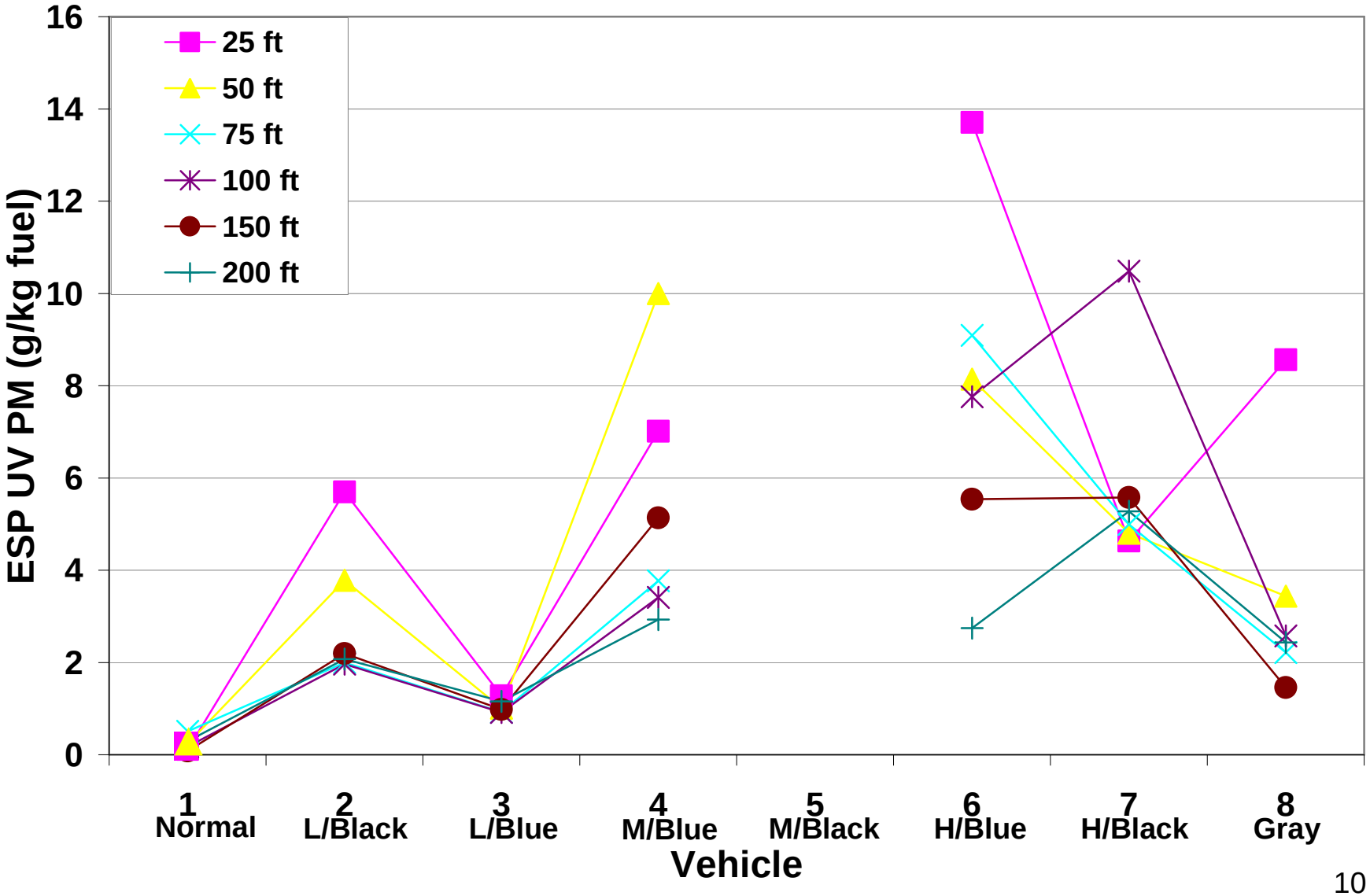
RSD Results: ESP UV Transmissometer



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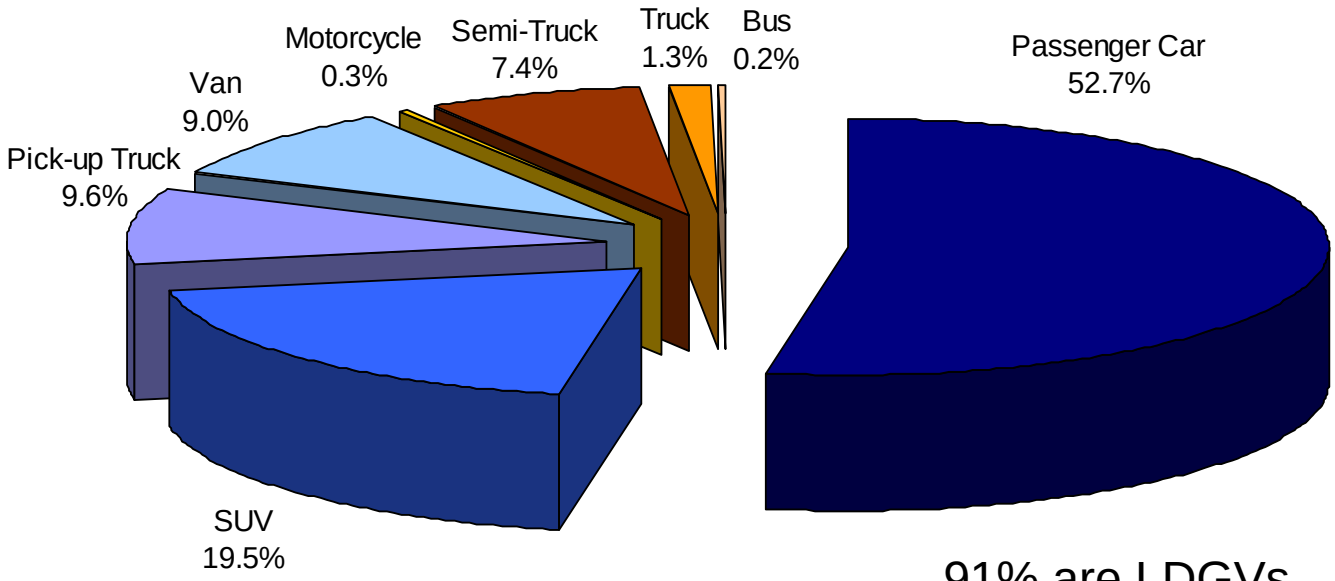
RSD On-road Testing

- Time: between 6:45 AM and 3:50 PM on July 27, 2006 (Wednesday).
- Location: south side on-ramp of the I-10 Freeway (East) of La Brea Avenue.
- Sample Size: in total 4,225 records



91% are LDGVs

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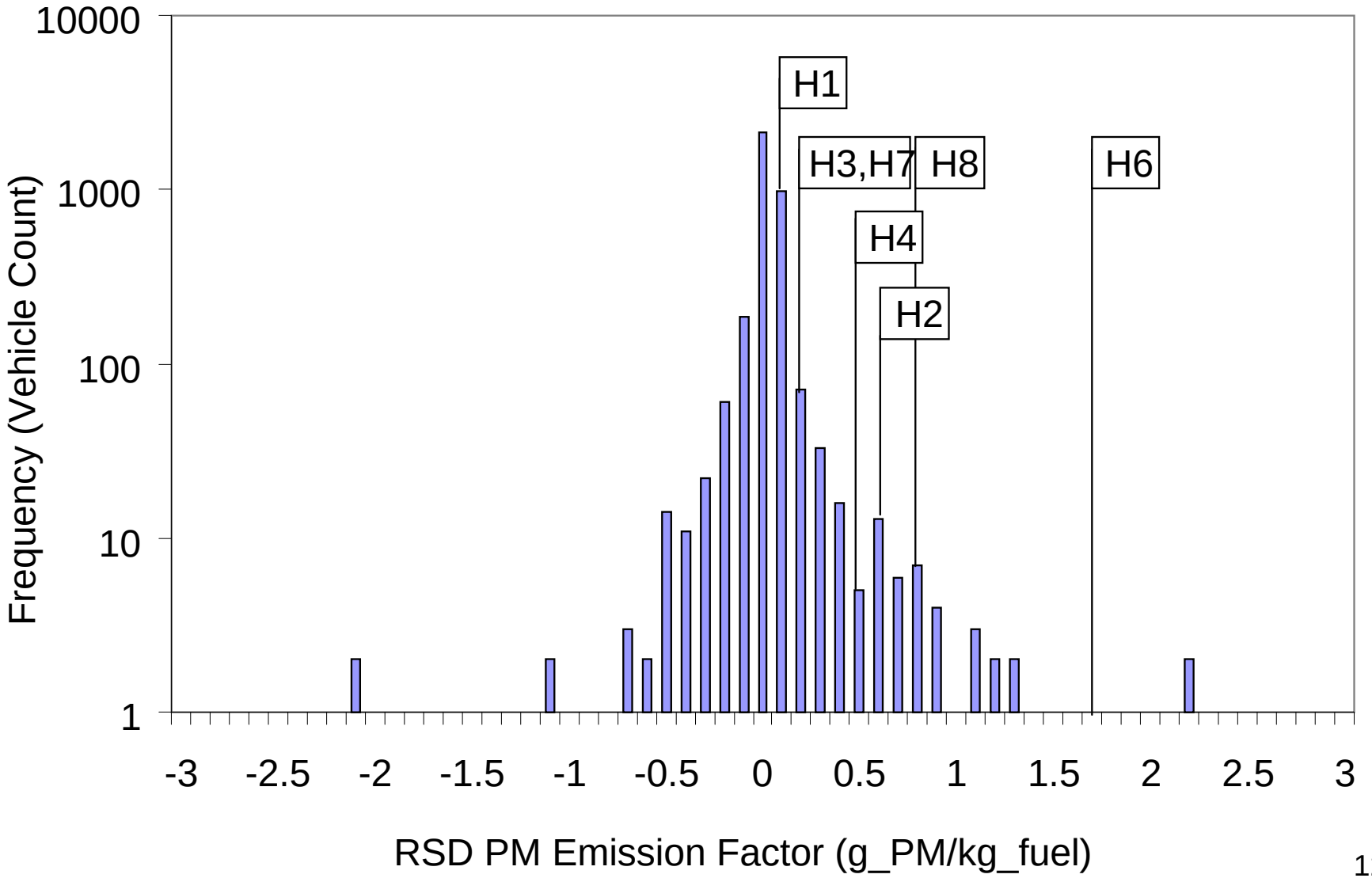
On-road Results: DRI UV LIDAR



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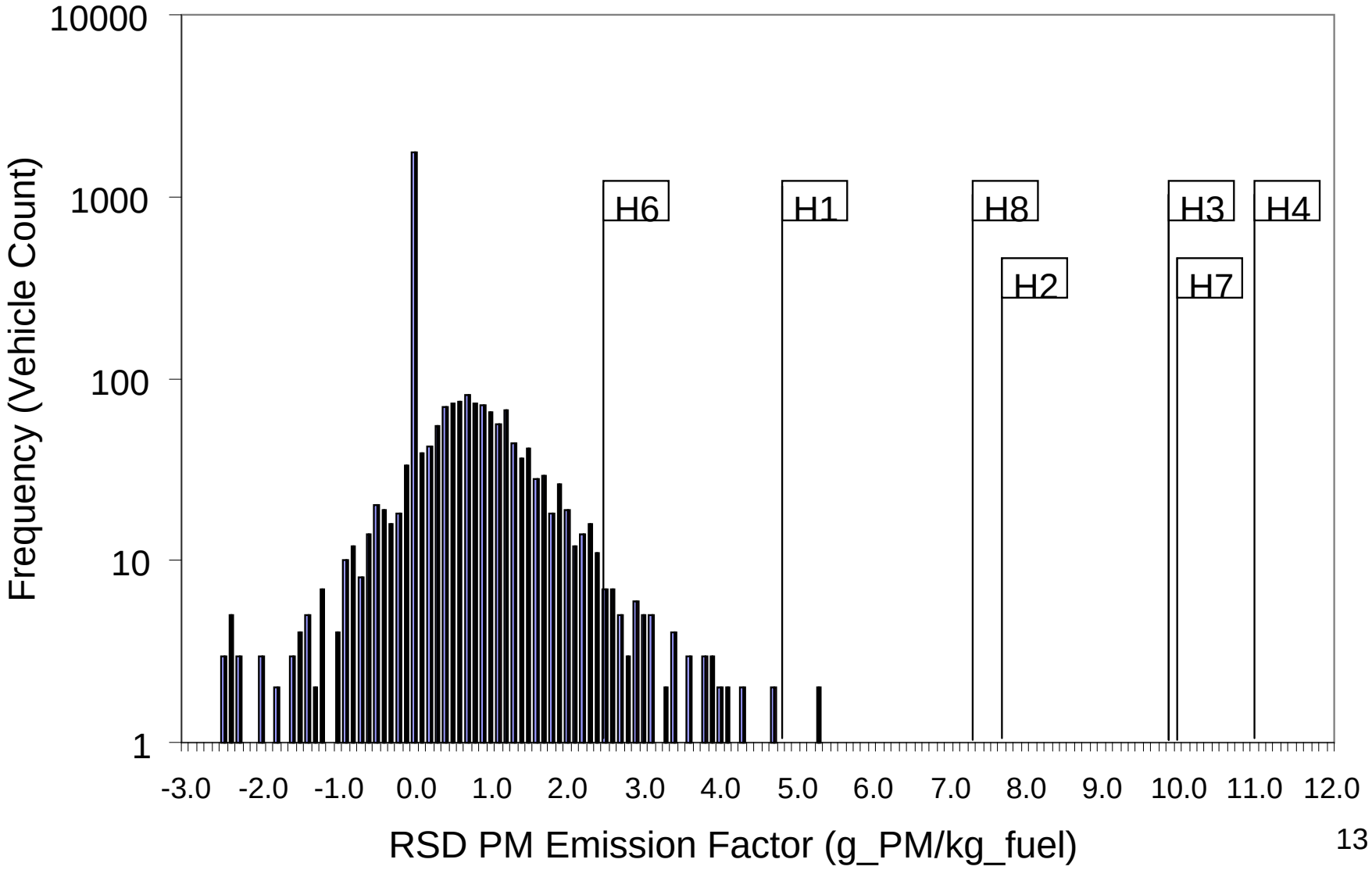
On-road Results: ESP IR Transmissometer



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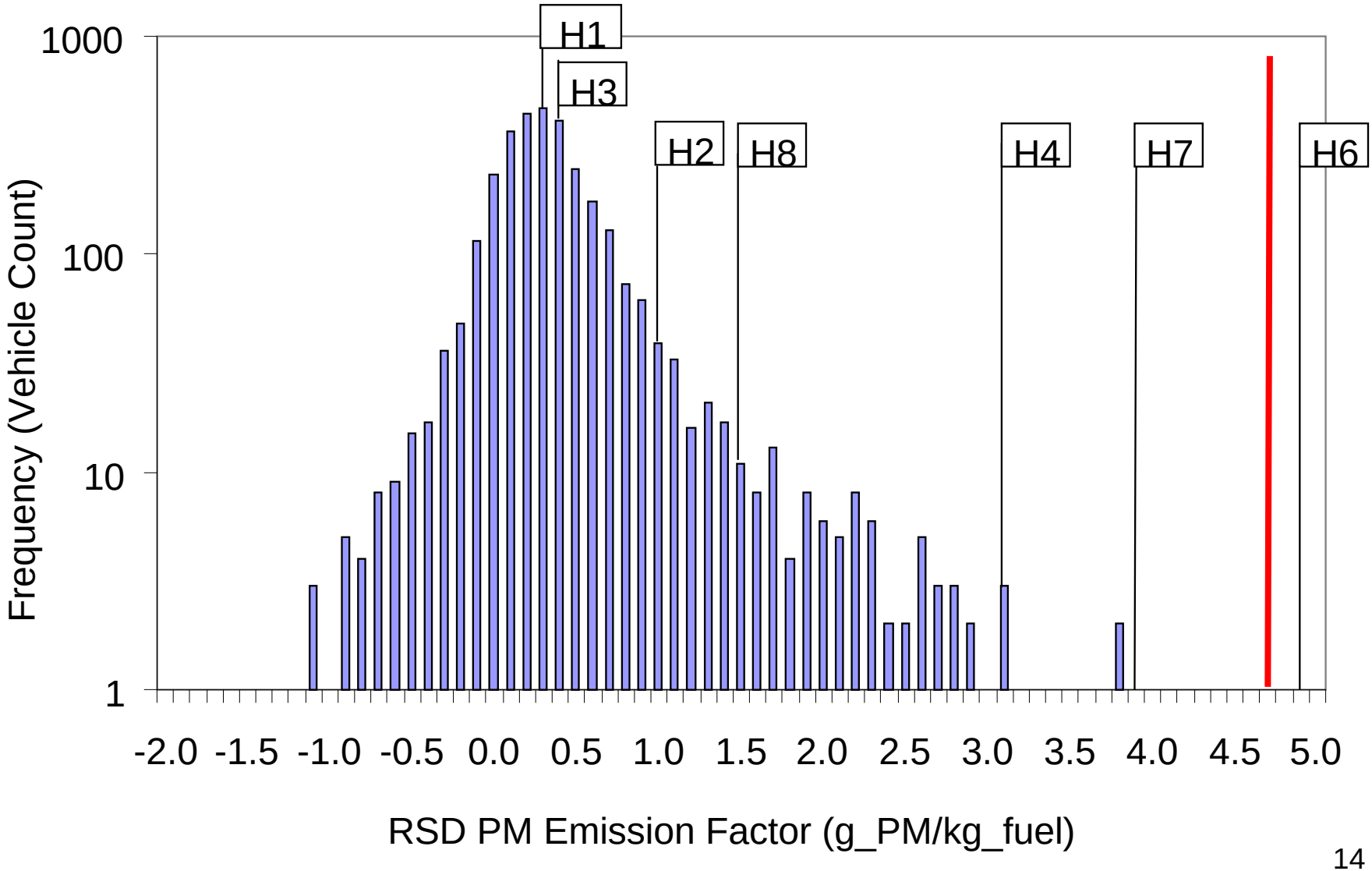
On-road Results: ESP UV Transmissometer



Conclusions

- RSD systems show promise for classifying the on-road fleet into Low/Med/High emitters. But more work is needed to increase confidence.
- Short test distance is better for RSD to capture the vehicles exhaust.
- A follow-up RSD study is anticipated to scan thousands of vehicles and define more precisely the appropriate cut point of “high” PM emitters.
  - by population.
  - or by emissions rate.